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Special theme: Provenance –
best practice, testing the 'local is
best' paradigm, evidence base for
Cumberland Plain and more

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ANPC National Office

GPO Box 1777
Canberra, ACT 2601, Australia
T (02) 6250 9509 | **F** (02) 6250 9599
E anpc@anpc.asn.au
W www.anpc.asn.au

National Office Staff

Martin Driver, Jo Lynch, Carly Westbye

ANPC Committee

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President Sarah Beadel
Secretary Rewi Elliot
PO Box 2199, Wellington, New Zealand
E info@nzpcn.org.nz
W www.nzpcn.org.nz

Australasian Plant Conservation

Editor
Paul Adam

Editorial Team
Linda Broadhurst, Kate Brown,
Anne Cochrane, Chantelle Doyle,
Paul Gibson-Roy, Michelle Haby, Jo Lynch,
Cathy Offord and Carly Westbye

Layout & Graphic Design
Siobhan Duffy

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**The deadline for the December 2017 –
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The special theme for the issue is *Papers from the
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Front cover: Plant Identification Workshop
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From the Editor

PAUL ADAM

The theme of this issue is provenance. 'Provenance' is one of those broad terms that we use a lot, and we think we know what it means, but it actually covers a range of issues for best conservation practice that need to be disentangled. The usual paradigm that is debated is 'local' versus 'broad' provenance, but what does this mean and why is it important?

The emphasis on 'local' provenance has deep roots in the empirical practice of pioneer bush regenerators in some parts of Australia, based on perceived patterns of plant variation and planting results, although rarely in an experimental framework and until recently with only limited genetic investigations. The long tradition of local empirical knowledge, and the associated tradition of reinforcing local resilience, needs to be respected, and reinforced by new science. The current debate is not unique to Australia, but has raised controversy overseas, particularly in Europe.

Important research in recent years has looked at 'provenance' from a different geographic and (because it is now possible) a more genetically informed standpoint, taking account of the fundamental issue of the 'genetic health' (by which is normally meant maximising genetic diversity) of the source material used for restoration and the limited and compromised gene-pools often used in restoration.

This issue of APC presents articles on only some aspects of 'provenance', but we hope this will be the start of more frequent articles and debate in these columns. The ANPC sees the clarification of provenance issues as vital for best practice. 'Broad vs local' is a starting point for this debate, but needs unpacking and by itself does not take us very far – and if used simplistically it may tend to entrench positions and attitudes without getting at the core underlying issues: genetic health, conservation of particular combinations of genetic variation which may be present in populations of a species only in a few locations or in particular habitats, capacity for effective reproduction, fitness of offspring, and potential for species recovery and future adaptation to threats and changing environmental pressures.

These are the core criteria that we need to use to inform our understanding of the provenance issue, to evaluate both research and practice, and to synthesise new forms of best practice based on a better understanding of biological and bio-physical reality.

Climate-change is one of the environmental threats which must be considered when determining the appropriate provenance to be used in particular circumstances, and discussion is often focussed on 'assisted colonisation' – the deliberate moving of plants from present locations to others which are predicted to experience similar climate conditions at some time in the future. Some of the ideas for refocussing restoration efforts to anticipate climate change are radical. The challenge of climate change adaptation, and the research findings around it, need to be promulgated carefully. Proponents need to avoid giving grounds for the taking of bureaucratic decisions to downgrade the importance of conservation and resilience of existing populations, and to reduce measures to address other existing non-climate threats. Sceptics need to recognise that new climatic realities require a new proactive and precautionary approach that pushes the boundaries of conservation practice as we have known it.

The issues around 'Provenance' are not simple. The scientific and empirical experience communities need to engage in continuing dialogue, and avoid the temptation to think that a binary (right/wrong) view is useful. Reality is more nuanced, and a 'one approach fits all' paradigm is rarely useful (except for an insistence on the core criteria noted above).

The exciting thing, that helps put much better conservation outcomes within reach, is that our knowledge and technical capabilities are better than ever, are increasingly able to be applied effectively and cheaply, and evaluated at local level, and can be used to leverage better and better-directed resourcing. What remains of fundamental importance is that all decisions need to be fully documented in data bases which need to be maintained for the long term.

Climate-ready provenance was the topic discussed at a recent workshop held at Kooyanga Golf Club in Adelaide in March organised by the Technical Advisory Committee of Trees for Life., and the first article in this issue is a summary of what was clearly a valuable and informative event, covering a range of topics of relevance across Australia.

Mark Tjoelker, Belinda Medlyn and John Drake present a study of a single species, *Eucalyptus tereticornis* (Forest Red Gum), which has a wide geographic distribution across a range of communities in south-east Australia. These findings do not show adaptation to local climate. In relation to climate there is no evidence that local provenance is 'best', but of course this does not mean that there is not adaptation to other environmental factors. The authors also point out that their finding does not mean that climate change will not have impacts on the species.

Peter Ridgeway, Daniel Smart and Damien Vella discuss variation of the local scale in a herbaceous plant *Scaevola albida* var. *pallida*. In restoration plantings, other than in grassland, there is a tendency not to give much attention to herbaceous elements but to concentrate on shrubs and trees, but this study shows that there can be considerable variation within herbaceous species and, as genetic variation is one component of biodiversity, recognition and conservation at this level of diversity is important. The authors are strongly critical of the climate-ready revegetation approach, and I am sure that this will stimulate debate. The suggestion that there is a sharp dichotomy between climate-ready and other approaches is not how I would read the climate-ready guidelines and other literature. However, the fact that there are other interpretations suggests that some clarification is perhaps required. There will be species and circumstances where the climate-ready approach is an option to be considered and possibly adopted, but there will be others where a different approach may be required. In an ideal world we

would know about the ecology and genetics of all species in a community before making decisions, but there will be many occasions when we will not have the luxury of being able to wait until all information is available. We need to recognise that a range of possible options may be available, and develop protocols for decision making when there might be uncertainty.

In the case of species with limited geographical distribution and small populations then options for choice of provenance are very limited and options for assisted migration may not arise. Two such species are discussed in articles by Bell and Henery. Stephen Bell presents a study of *Banksia conferta*, a species with a very restricted distribution in NSW, disjunct from other known populations in Queensland. Seed production is low, and Bell suggests that this may reflect pollinator limitation, and any conservation measures for the species would need to consider how that issue can be managed. Martin Henery discusses *Zieria murphyi*, a small shrub in the NSW Southern Highlands, describing a recent intensive survey and seed collection expedition which has substantially increased the amount of seed in the Australian National Botanic Garden's seedbank, and recorded increases in the known size and extent of distribution of the species.

Part of the ANPCs role is to encourage the interest of young people in plants and plant conservation, and Carly Westbye is active in developing a Kids Hub of projects for children of all ages. Carly provides an introduction to this aspect of her work and encourages others to contribute to the continuing development of the program.

In addition to the articles the issue has a rich collection of regular Features, including news from the Seedbank Partnership, reports of workshops (again highlighting the enthusiasm of our indefatigable Project Manager Martin Driver), book reviews and the Research Round Up.

Best practice provenance for a changing climate: a workshop summary

DOUG BICKERTON^{1*}, VICKI-JO RUSSELL², MARTIN BREED³, RUBY WAKE¹, NATASHA DAVIS², NOLA HANCOCK⁴, LINDA BROADHURST⁵, ANDY LOWE³ AND MARK ELLIS⁶

¹Department of Environment, Water and Natural Resources, South Australia, ²Trees For Life, South Australia, ³University of Adelaide,

⁴Macquarie University, ⁵Centre for Australian National Biodiversity Research, CSIRO NRCA, ⁶City of Burnside, Adelaide

*Email: Doug.Bickerton@sa.gov.au

Introduction

Trees For Life (TFL) is a not-for-profit organisation working to revegetate South Australia and conserve its remnant vegetation, with a focus on achieving effective on-ground results. Formed in 1981, TFL has volunteers who grow native seedlings at home for landholders across the state. TFL has a large propagation nursery that handles orders from local councils and industry. The organisation currently has 8,000 members including approximately 2,000 volunteers. Trees For Life also has a large volunteer program, Bush For Life, which supports and trains approximately 1,000 volunteers to undertake bush regeneration in remnant bushland.

Within a few years of its inception, TFL realised the need to develop a seed-sourcing policy. The use of local provenance in revegetation was recommended, with the rationale that plants from locally sourced seed are likely to be better adapted and provide more suitable habitat for local fauna, and less likely to become a weed or hybridise with related species.

Provenance zones were set up across the 'settled areas' of South Australia, and seed collectors were asked to collect from a list of species within each zone. TFL now has 42 provenance zones, and a total of 236 species listed for collection and propagation (1545 species-zone combinations across the State!).

TFL's Technical Advisory Committee (TAC) recently reviewed the provenance policy with respect to climate change adaptation. The Committee decided to host a workshop to provide South Australian revegetation planners and practitioners the opportunity to explore emerging best-practice seed provenance principles, and identify ways to collaborate and manage relevant issues.

Workshop

A workshop titled 'Best Practice Provenance for a Changing Climate' was held at Kooyonga Golf Club on 22 March 2017. Three guest speakers presented, and in attendance were staff from TFL, the Department of Environment, Water and Natural Heritage (DEWNR) including some NRM regions, local councils, Local Action Planning groups, Greening Australia, Conservation SA, Nature Glenelg Trust and the University of Adelaide.

Session One – Keynote Speakers

Nola Hancock (Macquarie University), lead author of the 'Climate-ready Revegetation Guide' (Hancock *et al.* 2016) provided an overview of the Guide, which advises revegetation planners and practitioners on climate change impacts and appropriate responses for project design. She stepped through the Guide's recommendations, highlighting some available online tools, including climate projection models and current and projected climate envelope models for species. Nola explained various provenance selection strategies currently available to practitioners, e.g. Local, Predictive, Composite, Admixture and Climate-adjusted (Figure 1), and reminded participants that climate is not the only factor to which species must adapt.

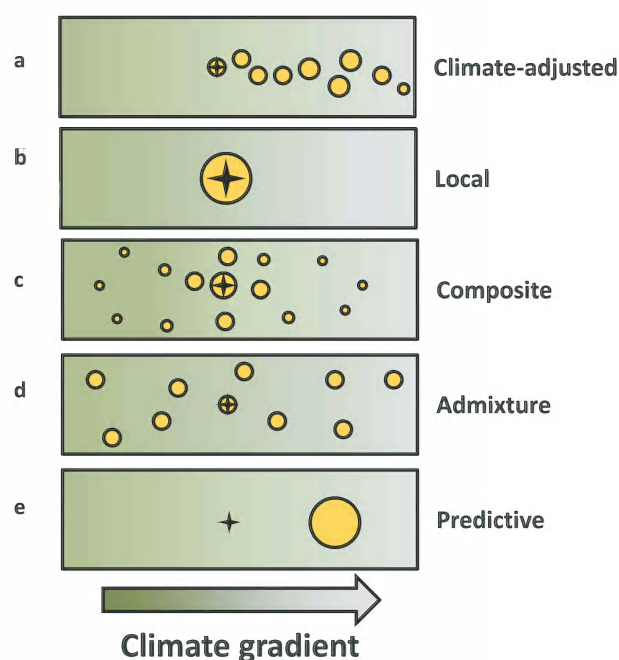


Figure 1. Provenance strategies for revegetation. The star indicates the proposed revegetation site, and circles represent populations of the species. The size of the circles indicates the relative quantities of germplasm included from each population for use at the revegetation site. Climate change is represented as increasing aridity but other dimensions (e.g. decreasing rainfall) could be used. Modified from Prober *et al.* (2015).

Linda Broadhurst (CSIRO) spoke about seed-based restoration. She pointed out that climate change is likely to affect many factors relating to future revegetation, such as declining seed availability for harvest, variation in the break of season causing uncertainty for planting times, increases in planting failure and extreme weather events damaging plantings. In planning future projects, it is increasingly important to consider the potential for maladaptation, outbreeding depression, hybridisation, mismatched timing of mating mechanisms, availability of seed and the seasonal variation in seed quality.

Linda stressed the need to maintain adaptive potential through genetic diversity. It is often assumed that plants have strong local adaptation; however adaptation is much more than a response to climatic factors, and much of the current research shows that plant populations often display little or no local adaptation. When defining 'local', it is difficult to generalise across species that may have a range of growth forms and pollination vectors. Additionally, there is no evidence that a 5km radius is a useful standard for determining provenance.

Andy Lowe (University of Adelaide) presented evidence that the use of local provenance can increase the likelihood of maladaptation, and that plants from small populations in fragmented landscapes display lower fitness. His take-home messages were to collect from larger remnant populations, select provenance strategies that increase genetic diversity and future adaptation, engage with universities to embed scientific experiments into restoration plantings, and measure planting successes and ecosystem function rather than inputs like stems/ha.

This **first session** inspired a robust discussion, including:

- current and potential experimental plots in SA;
- feeding data into a national network of experiments;
- the need for a national umbrella group to act as a collective voice for practitioners and advocate for restoration research;
- the role of citizen science; and
- the ongoing importance of fostering connectivity between fragment remnants to increase gene flow.

Session Two – Experience from the field

Examples were provided of provenance policy and practice from three different organisations.

Doug Bickerton (DEWNR) explained the policy setting for native plant and seed collection in South Australia. Native plant collection permits are issued under the *Native Vegetation Act 1991* for scientific research, bush food collection, individuals, commercial interests, community groups and botanic gardens. The current Native Plant Material Collection Policy encourages the use of locally sourced seed for revegetation, but does not define 'local provenance'. This policy is currently being updated.

In South Australia, collection permit applications for flora listed under the *Environment Protection and Biodiversity Conservation Act 1999* are only approved on condition that the applicant works with the relevant recovery team if one exists, and also writes a translocation plan akin to the ANPC Translocation Guidelines (Vallee *et al.*, 2004), which discusses 'provenance' in terms



Figure 2. Andy Lowe and Linda Broadhurst wrap up the final discussion session of the Trees for Life workshop on Provenance and Climate Change in March 2017. Photo: Doug Bickerton

of genetic suitability. The guidelines are also being updated to address current best practice, including provenance in a changing climate.

Mark Ellis (City of Burnside) spoke of the active biodiversity programme in Burnside, a suburb in the eastern foothills of Adelaide. The Council's plan is for connected, resilient and biodiverse landscapes using local native plants, i.e. indigenous plants found naturally in Burnside. The 'local' concept is well supported by management and the community, but is potentially a deterrent to trying new approaches.

Burnside Council's nursery produces 10,000 plants per year, all sourced locally. Mark discussed the community's pride in its local provenance plantings, and the challenge of introducing a new conversation around provenance. Mark believes the Council faces significant issues, including: is it viable to manage small remnants effectively into the future using current practices? Alternatively, for species found in low numbers at fragmented sites, what is the risk of swamping the Burnside gene pool with introductions from non-local sources?

Vicki-Jo Russell (TFL) outlined TFL's history (see Introduction) and how their strategy of using local provenance has driven their revegetation programme for more than 30 years. It is clear from TFL's nursery orders that a five kilometre radius provenance collection policy is still favoured by many councils. Vicki-Jo discussed the 42 provenance zones used by TFL, most of which are large (some span more than 100 kilometres). Zones are defined by both ecological and socio-political factors, including Council boundaries.

TFL's TAC recently reviewed the zone boundaries and recommended only minor changes. TAC also recommended composite provenance mixing for some longer-lived common species in high demand, e.g. River Red Gum (*Eucalyptus camaldulensis*). TFL's seed sourcing policy is based on assuring collection from a diversity of plants, with a growing emphasis on collecting from drier parts of zones. Seed availability is an emerging issue due to seasonal variation, declining remnants and extreme weather events.

In the subsequent discussion, participants recognised the value of the composite provenance option for smaller zones, whereas the larger zones are usually large enough to include several seed sources from across different climates. Participants also recognised the importance of the cultural overlay when trying to develop the perfect provenance strategy. It took a long time for some people to accept the 'local is best' concept, so some will find it difficult to change again. Equally we have moved from a position with no provenance strategies, to adopting local provenance principles, and are now challenging these all within 30 years, so we know change is possible.

In the afternoon session participants explored the current barriers to changing practice, opportunities for collaboration, and useful policy and principles. Three issues emerged as central, and were further discussed: **(1) improving seed collection and storage data; (2) developing seed sourcing guidelines for SA; and (3) the importance of collaborating and advocating as a unified sector.** Following these discussions the plenary group agreed on the following set of recommendations for future priority and action.

TFL's TAC will work with the participants to raise awareness of the issues, discuss with Government and seek opportunities to implement the recommendations.

Workshop Recommendations

Communication and collaboration:

- regular forums to facilitate collaboration and information-sharing.
- seed-sourcing guidelines addressing climate change and guiding data collection.
- improved seed collection data, storage and analysis to underpin decision-making.

Governance:

- a network for seed sourcing and revegetation to advocate for key issues and appropriate resources.
- a seed sourcing strategy to ensure sufficient supply of viable seed into the future.

Research and development:

- engage with researchers to test and improve provenance practices, contributing to a national network of experimental plots.

Acknowledgments

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Climate suitability of diverse provenances of a widely-distributed eucalypt: Testing the 'local is best' paradigm under climate warming

MARK G TJOELKER*, BELINDA E MEDLYN AND JOHN E DRAKE

Hawkesbury Institute for the Environment, Western Sydney University

*Email: m.tjoelker@westernsydney.edu.au

Environmental suitability of local provenances under climate warming

It is commonly recommended that revegetation efforts use local provenances (seed sources) of tree species, as they will be well-adapted to the local environment. As climate warms, local provenances may cease to be well adapted. It is argued that assisted migration through translocation of seeds or plants originating in warmer climates will ensure that local vegetation is 'climate ready.' There are myriad factors that can potentially shape the environmental suitability of a local provenance, including rainfall, soil type, fire frequency or competition, among others. However, for many tree species, the importance of temperature in determining environmental suitability is not known.

Moreover, it is generally unknown whether adaptation to temperature varies among provenances within a species. For widespread tree species, it may be argued that provenances should be suitable for planting anywhere within their native climatic range. However, widespread tree species often exhibit substantial variation within their range, with differences in morphology and growth observed along environmental gradients. If this variation is the result of spatially structured genetic differentiation along climatic gradients, then matching provenance to local climate might be important even when planting widespread species. Local adaptation to temperature in a provenance would represent a genetically based constraint on climatic tolerance and thus environmental suitability in the face of climate warming.

Thus, to determine whether consideration of temperature adaptation is important when choosing provenances, there are two key questions to address: first, how sensitive is the species to temperature; and second, how does this sensitivity vary among different provenances? Exploring these two questions in controlled temperature experiments provides a test of the 'local is best' prediction for provenances under climate warming.

Climate warming experiments with Forest Red Gum (*Eucalyptus tereticornis*)

We examined these questions in a series of glasshouse warming experiments with different provenances of *E. tereticornis*. This tree species is widely-distributed along the eastern coast of Australia, with a native range spanning approximately 2,500 kilometres and approximately 13°C in mean annual temperature from temperate climates in the south to tropical climates in the north. We used twelve diverse provenances originating from locations spanning the geographic and climatic range of this species (Figure 1).

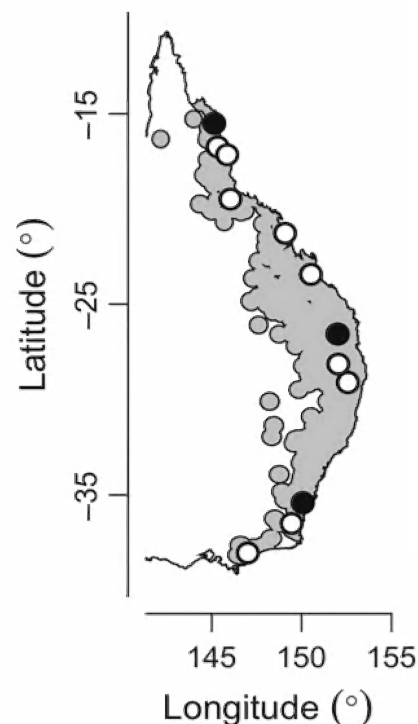


Figure 1. The distribution of *Eucalyptus tereticornis* in geographic space. Grey symbols reflect the species' native range as determined by occurrence records in the Atlas of Living Australia. White and black circles together denote provenances studied in a climate-shift experiment reported in Drake *et al.* (2015). Three of those provenances were selected and studied in a comparison of provenances experiment in Drake *et al.* (2017); these are denoted by black circles (reproduced with permission).

Climate shift experiment

In the first experiment (Drake *et al.*, 2015), we grew 12 diverse provenances from seed in an array of common-garden environments designed to represent local (home) as well as warmed (home + 3.5°C) conditions. Provenances were divided into four groups, which were each assigned to two glasshouses: one, a 'home' environment where the temperature mimicked mean summertime temperature conditions at the seed origin and two, a 'warmed' environment representing a climate shift of + 3.5°C. The range of home environments collectively spanned the native climatic range of the species.

We found that the 12 provenances differed in response to experimental warming of 3.5°C relative to their home climate-of-origin in a manner that depended on their geographic origin. Warming increased photosynthetic capacity and growth in southern cool-origin provenances, whereas the opposite was observed in northern warm-origin provenances, which exhibited reduced photosynthetic capacity and growth. Consequently, the capacity to cope with climate warming declines from temperate to tropical latitudes in this species. However, this experiment did not establish whether provenances from different parts of the species' range are locally adapted and thus differ in ability to cope with warming, particularly if translocated far from their provenance of origin.

Comparison of provenances experiment

We designed a follow-up study to distinguish whether or not cool-origin, central and warm-origin provenances were adapted to local temperature or shared a broad climatic suitability irrespective of climate of origin (Drake *et al.*, 2017). In this second study, the provenances were each grown in a full array of six mean summertime daily temperature regimes that spanned and exceeded the native geographic range of the species. We found that the temperature responses of photosynthesis and growth were equivalent across the three provenances (Figure 2), reflecting a nearly identical response to temperature despite a 2,200-km geographic distance and 13°C difference in mean annual temperature at seed origin. The climatically diverse provenances did not exhibit local adaptation to temperature in terms of their temperature sensitivity of photosynthesis and growth.

Conclusions

These two experiments demonstrate that *E. tereticornis* exhibits a broad and peaked response of photosynthesis and growth to temperature that mirrors the widespread native geographic and climatic range of the species. This leads to the prediction that increasing temperatures expected with climate warming will enhance growth in local provenances in the southern, cooler portions of the species' range, whereas local provenances in the northern, warmer portions of the range will exhibit little change or even declines in growth with warming (Figure 3).

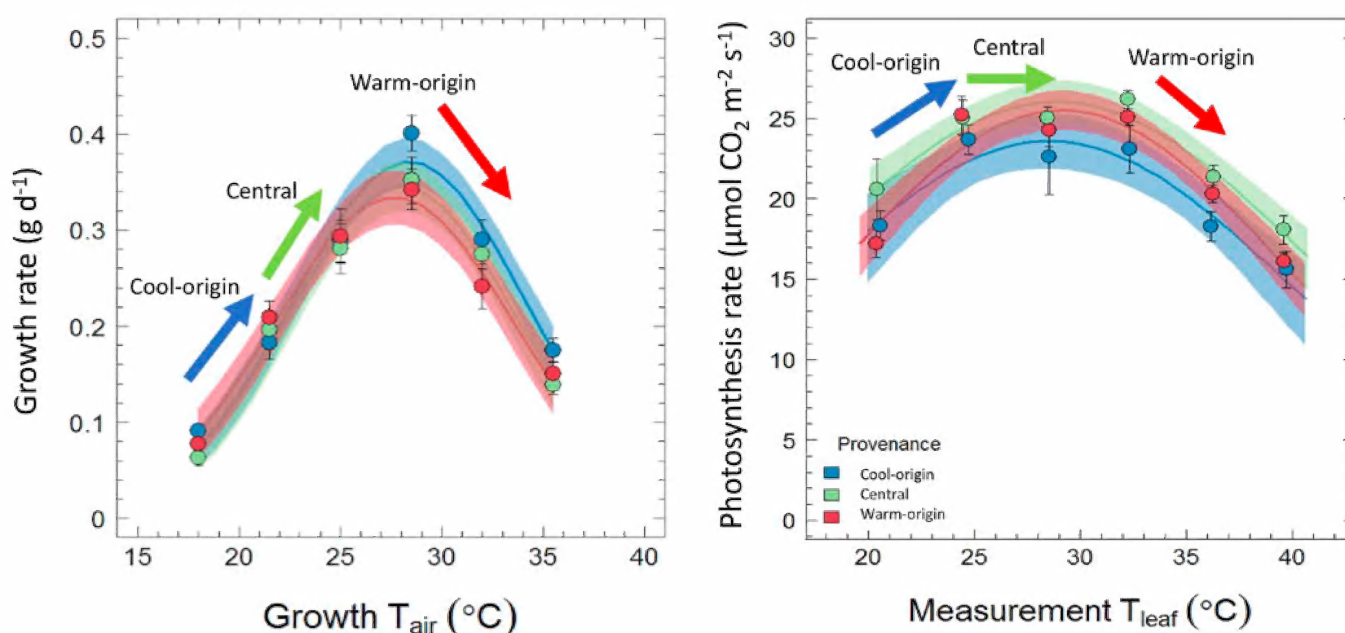


Figure 2. Temperature sensitivity of growth and photosynthesis in response to temperature of the growing environment in widely-distributed *E. tereticornis*. Each point represents either a cool-origin (blue, 18°C mean summer temperature), central (green, 21.5°C) or warm-origin (red, 28.5°C) provenance grown in each of six mean daily summertime growth temperatures that together span the entire native geographic range of the species. Growth was measured as dry mass growth rate (grams per day) and photosynthesis as light-saturated net photosynthesis of leaves (μmol CO₂ m⁻² s⁻¹) for plants measured under growth conditions. Symbols are the mean ± SE. Growth and photosynthesis respond to temperature with a peak near 28°C and temperature sensitivity did not differ among contrasting cool-origin, central, and tropical warm-origin provenances of *E. tereticornis* (Drake *et al.*, 2017). Arrows show direction and magnitude of each provenance's response to +3.5°C warming relative to their local climate.

Furthermore, the experiments provide evidence that provenances of *E. tereticornis* are not locally adapted in their temperature responses of photosynthesis and growth. The provenances all shared the same underlying temperature response functions. Consequently, in terms of temperature sensitivity of growth at the seedling stage, provenance choice for revegetation should not matter. In other words, we found no evidence that 'local is best' with respect to direct temperature effects on growth. Despite the lack of provenance differentiation in underlying temperature sensitivity, the impacts of climate warming will nonetheless vary across the geographic range of this widespread eucalypt species, depending on each provenance's local climate position on the species' temperature response curves for photosynthesis and growth.

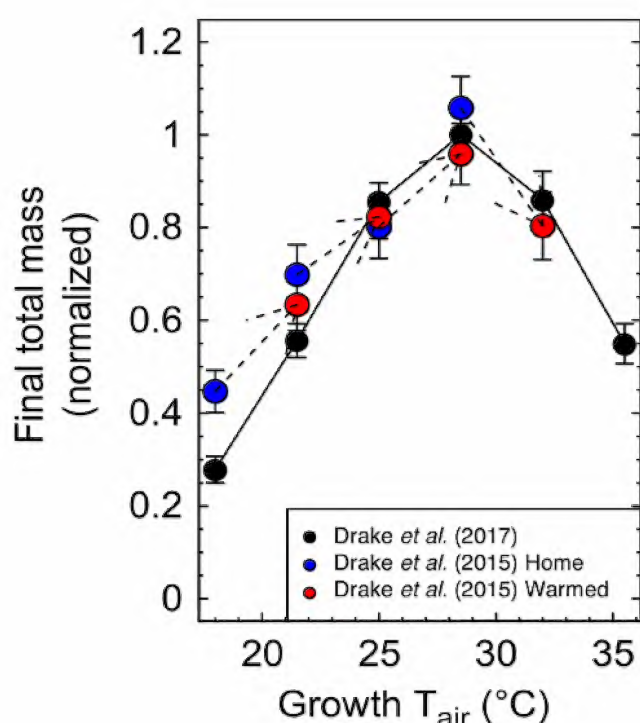


Figure 3. A comparison of temperature sensitivity of growth in two experiments with *E. tereticornis*. Growth was measured as final dry mass of harvested plants and was normalized to mean final mass at the peak growth temperature of 28.5°C. Points reflect the means and error bars reflect 1 SE. The data from Drake *et al.* (2017) are the combined and averaged responses of three provenances grown at all six temperatures, whereas the data from Drake *et al.* (2015) are the combined and averaged responses of four groups of three provenances grown in their respective temperature environments ('home' and warmed by +3.5°C). Dashed arrows show the directional effect of +3.5°C warming for each of the four provenance home groups.

The lack of local adaptation among provenances in temperature sensitivity of growth is perhaps surprising. Even though seed dispersal is typically rather poor in eucalypts, which in effect would preserve local genetic differences, long distance movement of pollen by bats and birds is one possible means for more widespread genetic mixing. In addition, the existence of abundant genetic variation within local provenances or weak selection pressure by temperature could also explain the lack of local adaptation along environmental temperature gradients.

Our studies were designed to isolate the direct effects of temperature. Other factors such as water and nutrient availability may modify the temperature sensitivity of growth or influence survival. In addition, our study examined seedlings, arguably a critical and environmentally sensitive bottleneck in terms of plant establishment. Yet temperature sensitivity in other life stages and processes, such as reproduction, remains an open question.

Nonetheless, these findings provide evidence that local adaptation to temperature among provenances in a widely-distributed species is less important than previously thought. Furthermore, provenance choice for replanting or translocation does not appear to be restricted by temperature of origin, perhaps expanding opportunities for wider seed source utilisation with climate warming.

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Evidence-based provenance: building informed provenance in the Cumberland Plain

PETER RIDGEWAY^{1*}, DANIEL SMART² AND DAMIEN VELLA³

¹Greater Sydney Local Land Services, ²Bunya Native Nursery Dural, ³Blue Mountains Botanic Gardens Mount Tomah

*Email: Peter.Ridgeway@lls.nsw.gov.au

Decisions about the choice of provenance of planting material for use in conservation and restoration programs have long been contentious. Some divergences are founded on differences in the objectives. We suggest that the debate is additionally confounded by inadequate testing of competing models using local information. Here we test some assumptions underlying 'local' (FloraBank 2010a, 2010b) and 'climate-ready' (Hancock *et al.* 2016) provenance models with data from the Cumberland Plain. We caution against generic application of provenance approaches and recommend that non-local provenance should be used only after analysis of local data to demonstrate the specific risks and benefits for the target species and landscape.

Is availability of local provenance sources limited?

To test this potential risk to using local provenance stock we selected four locations at random from the Cumberland Plain - one of the country's most heavily cleared landscapes. At each location (Marsden Park, Austral, Wetherill Park, and Camden) we analysed existing flora records from various distances from the potential revegetation site (Atlas of Living Australia 2017).

We found that within 5 km 30% of species were not recorded from at least one other site (27.1 - 33.5%, 1 S.D.) with a median of 3.5 recorded sites per species – conservative minima considering that most available remnants did not have Atlas records. Within 15 km 100% of species could be sourced from multiple sites. Even in this heavily cleared landscape we found no limitation on the potential availability of local provenance.

Can climate-ready provenance deliver species diversity?

The Climate Ready guidelines (Hancock *et al.* 2016) exclude the planting of any species not present at analogue sites (Step 2). To test the scale of this limitation we compared our Camden site (5 km radius) with its eleven climate analogue towns as determined according to the CSIRO Analogues Explorer (2090 projection, RCP 4.5 emissions scenario, and maximum consensus). Of the 311 known endemic species at Camden an average of just 92 (29%) and a maximum total of 267 (86%) occurred at analogue towns. Unlike local provenance there are fundamental and significant limits to the diversity possible for climate-ready plantings even if species are used as the unit of biodiversity.



Location map of the Cumberland Plain. Photo: Peter Ridgeway



Scaevola albida var. *pallida* dry (left) and intermediate (right) morphs grown together. Photo: Damien Vella



Scaevola albida var. *pallida* wet forest morph. Photo: Damien Vella

Does local provenance necessarily lack climatic adaptability?

A key assumption of the Climate Ready guidelines is that species ranges' reflect their climate tolerances. Species which have narrow climate tolerances are therefore discounted from climate-ready revegetation projects (Step 2). However a species narrow climatic *distribution* does not imply a narrow climatic *tolerance*. Potential distributional determinants are myriad and include stochastic factors. Most climatic-ready provenance programs have completely overlooked species' intrinsic climatic adaptability (Booth *et al.* 2015), despite a wealth of existing information on some species (e.g. Booth 2013).

As an example we interrogated the literature for the threatened species *Eucalyptus benthamii* from the Camden-Kedumba region. NicheFinder (www.nswnichefinder.net) confirms a narrow area of occupancy (116 km²) and narrow climate envelope (excluding known errors) of an annual mean temperature 16.2 - 17.7°C, minimum coldest month 3.4 to 4.3°C, and maximum warmest month of 28.0 - 30.0°C. However, we were readily able to find published literature demonstrating adaptability of the species to minima below -2°C and maximums above 35°C (e.g. Hall 2015). This important local species is inappropriately and needlessly discounted from plantings by the Climate Ready guidelines.

We similarly interrogated the literature for evidence of competitive advantage of climate-ready provenance in Cumberland Plain. The only local studies found no growth advantage in climate-ready provenance relative to local provenance – despite a conclusion in favour of climate-ready provenance (Hancock & Hughes 2014; Hancock 2013).

Do species sufficiently capture biological diversity?

Use of Climate-ready provenance accepts that species are a suitable category to capture the biological diversity of local areas. However the Cumberland Plain contains

38 APC (Australian Plant Census) recognised subspecies and varieties. To investigate the fullest degree of differentiation we surveyed one variety (*Scaevola albida* var. *pallida* (R.Br.) Carolin) across an area of 15 sq km within the Cumberland and Fairfield LGAs. At each site we recorded any local morphs and grew stock under 'common garden' conditions to separate true-to-form traits (i.e. genetic) from environmental plasticity.

We recorded three true-to-form morphs of *S. albida* var. *pallida* in the study area, each correlated with modest differences in habitat.

Dry Prostrate morph: Plants prostrate; leaves small 10-19 mm length and conspicuously villous

Intermediate morph: Plants prostrate or somewhat so; leaves medium 19-25 mm length, occasionally with small, scattered hairs

Wet forest morph: Plants erect; leaves large 50-70 mm length, glabrous or scattered hairs along veins

Our purpose here is not to suggest a redefinition of *S. albida* var. *pallida* but to demonstrate that a degree of genetic differentiation occurs at small (<5 km) geographic scales and within the lowest recognised taxonomic ranks for some local species. Differences in local morphs can have serious functional implications for local adaptation (e.g. Bernhardt *et al.* 2016).

Conclusion

Provenance decisions impact not only the scientific integrity of landscapes but also their functional ecology. Climate change is a major threat to some native flora and has strong implications for restoration provenance. However, it is one factor among many for consideration. Our findings illustrate that standardised or 'universalist' climate-ready provenance is not necessarily supported by local ecologies and caution is needed to avoid needlessly excluding important species, relocating species with already sufficient climate adaptability

in local provenance, and reducing biodiversity through potential replacement of local forms, varieties and subspecies.

At present, there is no evidence of competitive advantage from climate-ready provenance in Cumberland Plain flora and no field assessment of climate-ready provenance risks to local ecosystems. These issues cannot be inferred from generalist models and the need for species-specific local data to inform these decisions presents considerable research opportunities. While the region has hosted a number of forums on generalised provenance models there is a clear opportunity to advance the discussion to better capture local field data & expertise and deliver a more modulated, interrogatory-based provenance practice. The authors would welcome interest and suggestions on how best to facilitate these discussions in the Cumberland sub-region and on how to better integrate local field expertise in provenance considerations.

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The challenge of improving *ex situ* collections for threatened plants: the example of the Velvet Zieria (*Zieria murphyi* - Rutaceae)

MARTIN HENERY

Australian National Botanic Gardens, Parks Australia
Department of the Environment and Energy, Canberra, ACT
Email: martin.henery@environment.gov.au

One of the main aims of the recently completed Saving Threatened Species project at the Australian National Botanic Gardens (ANBG) was to identify plant species listed under the *Environment Protection and Biodiversity Conservation (EPBC) Act* 1999 that have low levels of genetic diversity held *ex situ*. This included an assessment of the seed and living collections at the ANBG as well as the Royal Botanic Gardens Victoria and in NSW. A genetically representative *ex situ* collection of a species is essential if that material is to be used to reverse species declines or prevent extinctions. One of the threatened species identified in this process was *Zieria murphyi* commonly known as the Velvet Zieria.

Reasons to improve *ex situ* collections of the species

Zieria murphyi is a small shrub endemic to the Sydney region. The species grows in open, dry sclerophyll forest, in sheltered sites on sandy soils over sandstone (Armstrong 2002). The species has trifoliate or occasionally unifoliate leaves covered in a layer of hairs, which is very soft to the touch, hence the species common name. It produces small, white to pale pink flowers in spring (October-November). The species has a disjunct distribution with one known population recorded in the Blue Mountains near Mt Tomah and

others in the southern highlands, at Penrose/Bundanoon (Armstrong 2002; Harden 1991). The populations in Blue Mountains and Morton National Parks number fewer than 1000 plants (Briggs & Leigh 1996). Perhaps surprisingly, given the small numbers and the restricted distribution, it is only listed as Vulnerable under the EPBC and the NSW *Threatened Species Conservation* Acts. Very little is known about the species ecology and although the most significant populations are located within conservation reserves it is unknown whether the species is declining or stable and what environmental conditions are required to maintain populations.

The species was not well represented in seed banks or in botanic gardens. The ANBG holds an accession from the Mt Tomah population in the living collection obtained in 1991 but the number of genotypes represented may be as few as one. The Australian Botanic Garden Mount Annan holds only small seed collections from one site at Bundanoon and the Mt Tomah population. Thus for conservation purposes this species could be considered as poorly represented *ex situ* and an ideal target to improve the diversity held in *ex situ* collections for the species. *Zieria murphyi* is not currently a target for NSW Saving Our Species funding despite perhaps being deserving of research and conservation actions. Thus there was added value in contributing to information about the species status in the wild whilst collecting and securing a significant *ex situ* collection to help insure against potential loss of the species.

An added imperative to focus on the species was based on the observed decline in abundance at its best known location in Morton National Park near Lovers Walk at Bundanoon (K. McDougall, pers. comm). Monitoring by the NSW Office of Environment and Heritage (OEH) has shown this population now numbers 15–20 plants, reduced from approximately 130 plants in 1996. An unsuccessful attempt to burn this site to stimulate some population recovery was undertaken in 2016 but

the fire did not reach the *Zieria* plants (G. Bush, pers comm.). The reason for the decline at this site is not clear although the vegetation structure has changed considerably over the period (K. McDougall, pers comm). This population is now so small that it is not feasible to achieve a seed collection of significant size from it. Thus it was necessary to locate additional populations in the Bundanoon/Penrose area from which to collect seed.

Aside from the known population at Lover's Walk, there are numerous records for *Z. murphyi* in the Bundanoon/Penrose area, both recent and historical, including what is presumably the eponymous type specimen collected by Ethleen Murphy in 1938. The feature of the majority of the reliably located records is that the species occurs in a narrow strip of habitat along the upper margins of deeply incised gullies that are eroded into the sandstone plateau and drain the north-east section of Morton National Park. The habitat appears to be restricted to a small area of dry sclerophyll open forest that is perched above the closed forests and wetter gullies that form tributaries of Bundanoon Creek and Tallowa Gully. It is possible that areas adjacent to these deep valleys have specific climatic conditions that suit the species.

Locating the plants

For some threatened species surveying for and locating populations of species can be a significant undertaking and is often only possible with assistance of knowledgeable contacts and some detective work. It was apparent from OEH staff that no targeted survey for the species had previously been conducted in Morton National Park or surrounds. This is unsurprising as the terrain is very rugged and the vegetation dense. In addition the diminutive stature of the plants and its inconspicuous nature in the understorey meant that finding the plants was going to be a challenge. The largest population in the Penrose area within Morton National Park was estimated at 1000 plants in 1997.



Figure 1. *Zieria murphyi* flowers (left) and immature fruits (middle). Plant being inspected for fruit production (right) illustrates average size of individuals. Photos: Martin Henery

This population is currently regenerating after a hazard reduction fire in 2015 and although there has been significant recruitment from the soil seedbank, the plants are not yet mature enough to produce seed.

Significant progress towards identifying alternative sites was made by following up two suggested local contacts. Both had observed the species on private property neighbouring the national park. This in turn led to contact with the relevant landholders who granted permission to survey for the species and collect seed. In addition one helpful contact was able to guide us directly to the plants at one site. The lack of targeted surveys for *Z. murphyi* in the Bundanoon area meant that, even with this assistance, it required many days and multiple field trips to locate populations, survey them and, ultimately, collect seed.

Conservation outcomes

The two populations in the Bundanoon area were separated by 5.5 kilometres and one proved to be relatively large with over 200 individuals scattered along a 1 kilometre edge of the escarpment overlooking Coalmines Creek. The other population was much smaller both in area and number of plants and could very easily have been missed when searching for plants if traversing 50 metres higher across the slope on which

it was ultimately located. In common with other *Zieria* species and other Australian genera in the Rutaceae, the *Z. murphyi* seed is ballistically dispersed from the dehiscent fruit. This necessitated collections to be made by bagging late-flowering inflorescences on individual plants to collect seed at a later stage. This resulted in a significant seed collection of 4700 seeds collected in 34 single plant maternal seed lots widely spaced across the two populations. The size and extent of these populations were also estimated.

The dry sclerophyll vegetation which comprises the habitat of the Velvet *Zieria* is prone to fire. As the species appears to be an obligate reseed, and plants are killed by fire, it is possible that it may have a higher reproductive effort immediately post fire when vegetation is more open. Thus some regular fire disturbance may be required to maintain populations. Given that the largest populations are in conservation reserves the threat to the species appears to be fire regimes that negatively impact populations. However with little ecological knowledge of the species, it is not known what timing or intensity of blaze would enhance or maintain populations. Another potential threat is that *Z. murphyi*, in common with several other highly threatened members of the genus in NSW, appears to be preferentially browsed by native mammals, most



Figure 2. The author bagging a *Zieria murphyi* to collect seed in typical habitat near Penrose/Bundanoon (left) which is commonly in sheltered sites above deep valleys in the north of Morton National Park (right). Photos: Brian Hawkins.

likely Swamp Wallaby (*Wallabia bicolor*). It is currently unknown whether this is detrimental to persistence at some sites although it was observed that browsing resulted in reduced seed set and intensive browsing potentially contributed to the death of plants in some areas (M. Henery, personal observation).

Conclusions

Small populations of small, perennial plants generally produce small annual seed crops and present a great challenge for seed collection. In addition, seed production may be further impacted by environmental factors such as herbivory or time since fire. For a poorly known and little studied species like the Velvet Zieria a significant investment in time and effort to gather intelligence can reap rewards when attempting survey and collections. The seed sample now obtained will enable long-term storage in the National Seed Bank at the ANBG as well as enabling germination experiments to assist identification of optimum germination conditions for the species. Knowledge of germination requirements is essential if

enhancement of wild Velvet Zieria populations using collected seed is to be undertaken in the future.

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New insights into the ecology of the critically endangered *Banksia conferta* (Proteaceae) from the mid-north coast of NSW

STEPHEN BELL

School of Environmental and Life Sciences, University of Newcastle, NSW
Email: stephen.bell@newcastle.edu.au

Introduction

Banksia conferta A.S. George (Proteaceae; Figure 1) is an erect tall shrub occurring within a restricted range in the rugged forests of northern New South Wales. Additional populations are also present in south-eastern Queensland (Mt Barney, Lamington Plateau, Glasshouse Mountains), the closest some 400 kilometres to the north. Listed as Critically Endangered on the NSW *Threatened Species Conservation Act 1995*, this species has been allocated to the *site-managed stream* under the NSW Government's Saving our Species program (SoS)¹. In New South Wales, *Banksia conferta* is currently only known from Coorabakh National Park on the Lansdowne Plateau, near Taree on the mid-north coast.

George (1981) initially described *Banksia conferta* from material collected at the Glasshouse Mountains in

Queensland, detailing two varieties: var. *conferta* (from Queensland and Coorabakh National Park) and var. *penicillata* (from the Greater Blue Mountains, NSW). More recent taxonomic work based on detailed cladistics analyses raised both of these varieties to specific status (Thiele & Ladiges 1996). In New South Wales, only *Banksia conferta* is considered threatened: populations of *B. penicillata* are similarly restricted in range but support sizeable populations in secure conservation areas and with few threats (Bell 2008).

During 2016-17, a lapsed *Banksia conferta* monitoring program initially established in 2008 by the NSW National Parks and Wildlife Service was reinstated under the SoS program. This aimed to revisit existing monitoring plots to assess how the *Banksia conferta* population was progressing following a wildfire in 2009, and to address general concerns over observed low recruitment rates.

¹ <http://www.environment.nsw.gov.au/savingourspeciesapp/Project.aspx?results=c&ProfileID=10514>



Figure 1. Mature *Banksia conferta* plant, Coorabakh NP. Photo: Stephen Bell

The last full census of this population occurred eight years prior to the recent monitoring event. Following re-census, new insights into two key ecological traits were gained: pollination limitations and response to fire.

Low seed set

Observations on flowering and fruiting within monitoring plots and in the surrounding population found that despite copious and regular flowering of mature *Banksia conferta* plants over many years, only a very small proportion of infructescences (fruiting heads) (9 of 144, or 6% of all inspected) had been fertilised and carried seed. This scarcity of fruiting follicles was strongest in the preceding 5-6 years, but in some instances up to 20 consecutive flowering seasons have failed to produce seed. Banksias are commonly pollinated by birds or arboreal mammals (Hopper 1980; Goldingay 2000; Hackett & Goldingay 2001), and populations of these vertebrates within Coorabakh may be too sparse to effect sustained and regular pollination. It seems plausible therefore that *Banksia conferta* is a pollinator-limited species, currently threatened by this paucity of pollinators. This may be a natural, cyclic event reflecting

the prevailing environmental conditions, as vertebrate fauna populations change in response to predation, available food or shelter resources. Alternatively, the long history of logging in Coorabakh, prior to it becoming a national park, may have progressively and negatively impacted on the smaller arboreal possum fauna that may historically have been important in the life cycle of *Banksia conferta*.

The habitat in which *Banksia conferta* occurs at Coorabakh is distinctive in the lack of co-occurring species which also require vertebrate pollination. Common associate species of *Acacia*, *Boronia*, *Ceratopetalum*, *Dillwynia*, *Leptospermum*, *Monotoca*, *Patersonia*, *Persoonia* and *Stylidium* are all predominantly insect pollinated, and provide no nectivorous reward for vertebrate foragers. The clear exception to this is *Banksia collina*, which occurs sympatrically but sparingly with *Banksia conferta* throughout Coorabakh. Fertilisation of *Banksia collina* appears to be regular and unimpeded, with fertile follicles present on most flower spikes. This presents an interesting scenario in which two *Banksia* species occur side-by-side, yet only one is successfully and regularly replenishing the seed bank.

Where are the pollinators?

It seems likely that an absence of small arboreal mammals within Coorabakh over an extended time period may be the key to a low fertilisation rate. In a study on the rare Eastern Pygmy-possum (*Cercartetus nanus*) in Queensland, Harris *et al.* (2007) found this species inhabiting open forest of *Lophostemon confertus*, *Eucalyptus grandis*, *E. saligna* and *E. microcorys* with a *Banksia conferta* midstorey, suggesting that this possum may play an important role in the pollination of *Banksia* there. This observation lends strong support to the work of Turner (1984, 1985), Bladon *et al.* (2002), Tulloch and Dickman (2006), and Harris *et al.* (2014) on the importance of *Banksia* spp. in the diet and habitat of this species. Indeed, Tulloch and Dickman (2006) stressed that *Banksia* spp. are the most important food source for Eastern Pygmy-possum, with nearby *Eucalyptus* and *Xanthorrhoea* spp. (both common within *B. conferta* stands in Coorabakh) providing the necessary shelter.

To further explore this possible absence of pollinators, a desktop assessment of small arboreal mammal populations in the Coorabakh NP area was undertaken. This review of the NSW Bionet Wildlife Atlas database (Figure 2) showed only two records of Eastern Pygmy-possum (from 1997 & 2012) for the Kerewong and Comboyne State Forests area (approximately 6 kilometres north of Coorabakh National Park). Further afield, the nearest proximate records to *Banksia conferta* stands are approximately 25 kilometres to the east at Crowdy Bay National Park, and approximately 40 kilometres to the north-west at Mt Seaview. Similarly depauperate populations were found for other potential pollinating species. The Feathertail Glider (*Acrobates pygmaeus*) and Squirrel Glider (*Petaurus norfolcensis*) are apparently absent from Coorabakh National Park, the latter a species known to inhabit forest elsewhere where *Banksias* are prominent (e.g. Smith & Murray 2003). Only Sugar Gliders (*Petaurus breviceps*) have been recorded within close proximity to Coorabakh, but these are well distant (greater than 4 kilometres) from *Banksia conferta* stands. It is unknown if the low density of arboreal mammals reported in Bionet is a reflection of lower survey effort within Coorabakh National Park, or if it accurately portrays the resident possum fauna. Targeted surveys for arboreal possums may be necessary to clarify their presence within and around *Banksia conferta* stands.

Fire response

Banksias are well known for supporting an aerial seed bank, with seed released on death of the branch or plant through fire or other mechanical means. This process ensures that seed are deposited under appropriate conditions where competition from other species is low. Although some *Banksias* are fire-sensitive, adult plants dying with the passage of fire, many others develop a lignotuber and consistently re-sprout and proceed to

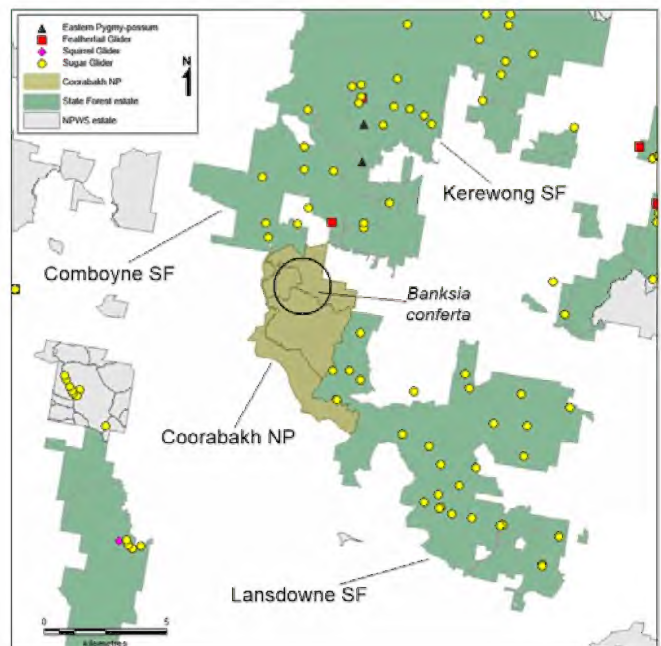


Figure 2. Distribution of small arboreal mammals within and around *Banksia conferta* stands in Coorabakh NP. Source: NSW Bionet Wildlife Atlas

flowering. The literature describes *Banksia conferta* as a fire-sensitive species, and one lacking a lignotuber (George 1999; Griffith 2005; NSW Scientific Committee 2007). This non-lignotuberous habit is one feature which has been used to distinguish the species from the closely related *Banksia penicillata* (George 1999). Fortunately for the *Banksia conferta* population at Coorabakh, a lignotuber is indeed present in at least some of these plants (Figure 3), and regeneration from these has occurred in the absence of true recruitment through seed germination (Figure 4). This finding has important implications on the future management of *Banksia conferta* at Coorabakh, as a change in monitoring to focus on identifying problems with pollination is perhaps now more pressing.

Conclusions

If, as seems reasonable, there is currently a paucity of small arboreal mammals within Coorabakh National Park, there is a real threat that a continuing decline in population will result in fewer and fewer *Banksia conferta* individuals recruiting into the population. In the short term, the lignotuberous nature of this species will ensure ongoing maintenance of plants, particularly the older individuals where it may be expected that advanced lignotubers have developed. However, ultimately pollination of flowering individuals will be imperative to safeguard against the threat of regular fire events. Future work looking into the densities and activities of potential vertebrate pollinators, and ways in which these species can be encouraged to return, are seen as key management actions into the future.



Figure 3 (left). *Banksia conferta* resprouting from a lignotuberous plate, with charred and burnt out older stem at right.
Figure 4 (right). Multiple stems of *Banksia conferta* resprouting from a lignotuber, possibly a single individual. Photos: Stephen Bell

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CARLY WESTBYE

Australian Network for Plant Conservation Inc

Office Administrator

Email: anpc@anpc.asn.au, admin@anpc.asn.au

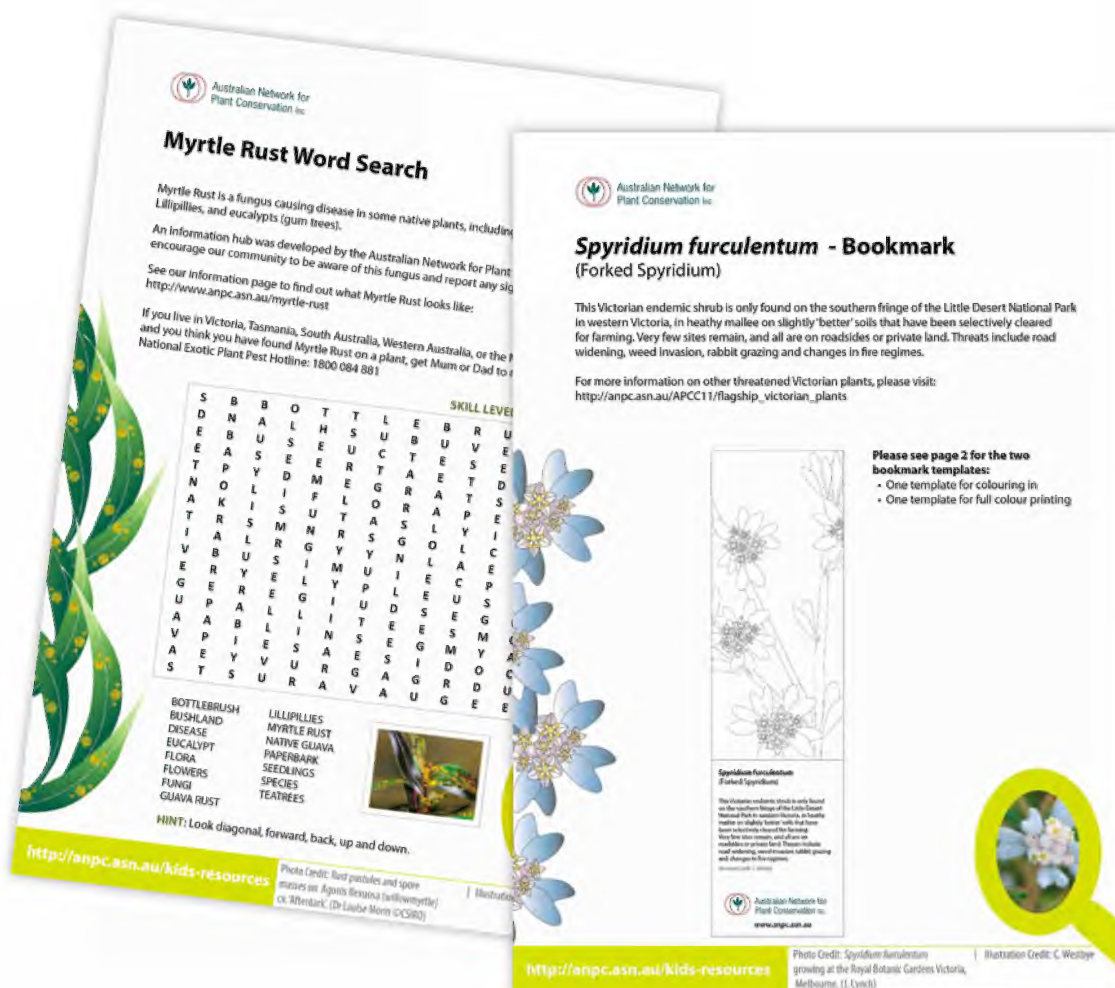
The Australian Network for Plant Conservation is working towards developing a Kids Hub containing FREE plant conservation projects for children of all ages with downloadable projects from our website. The page will continue with further development throughout the year. We urge teachers, parents, carers, and grandparents to help spread the word and encourage children to gain an understanding and awareness of our native plants and threatened plant species.

Some projects involve exploring the outdoors, learning how to identify native plants and seeds and collecting for fun projects. Other projects ideal for those rainy days include creating cards, bookmarks, colouring pages and much more for those special occasions.

We hope you enjoy this learning journey and look forward to viewing some of the tasks you have completed with the kids.

If you would like your work featured on our website, please scan a copy of your work and email to anpc@anpc.asn.au and your work will appear on our noticeboard for a period of four weeks pending the number of submissions received.

For more information please visit <http://www.anpc.asn.au/kids-resources>



Images: Project illustration – Carly Westbye ANPC Staff

News from the Australian Seedbank Partnership

The next chapter for the Australian Seed Bank Partnership (ASBP)

DAMIAN WRIGLEY

National Coordinator, Australian Seed Bank Partnership

Email: coordinator@seedpartnership.org.au

Background on the new National Coordinator

I joined the ASBP from the role of Knowledge Broker for the Australian Government's National Environmental Science Program (NESP) and Hub Liaison for the NESP Tropical Water Quality Hub. I supported the NESP Hubs to deliver research that informed environmental decision making at all levels of government, industry and communities. Before that I worked on assessing biodiversity values and proposed management planning for National Reserve System properties throughout Australia. I have a Bachelor of Science from Edith Cowan University and a Graduate Certificate in Environmental Science from ANU. Before I left Perth in 2006 I worked at the WA Department of Agriculture undertaking seed pathology trials for crop rust research. My partner is a gender equality expert, we have two young boys and besides plants I have a keen interest in spiders and reptiles.

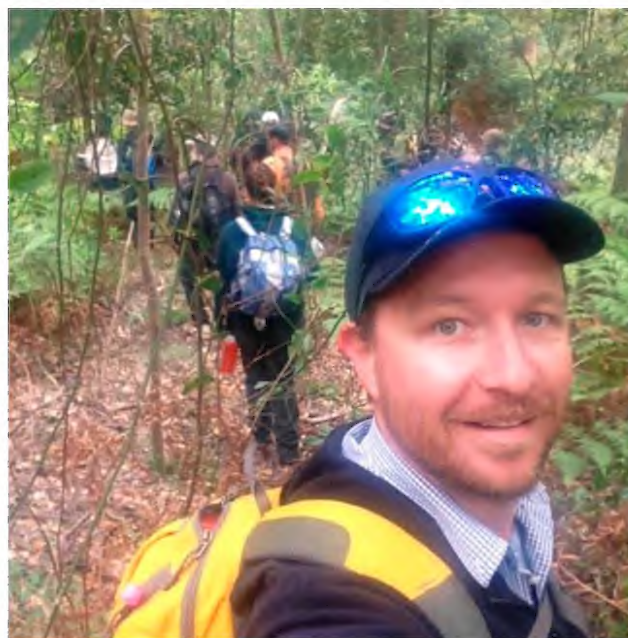
Thank you to the previous National Coordinator

I would like to congratulate Dr Lucy Sutherland on her appointment as Director of the Botanic Gardens of South Australia, and thank her for many years of dedicated service to the ASBP. I am also very grateful for the careful stewardship of ASBP by Jessica Pink and Elly Love during the months following Lucy's departure. Lucy has built a legacy of strong collaborative relationships between the ASBP and many organisations that continue to support a steady supply of accessions for conservation seed banking in Australia. Thanks to Lucy's leadership, the ASBP is well on its way to achieving our targets under the 1000 Species Project, as well as contributing significantly to the Millennium Seed Bank Partnership's global efforts to conserve viable genetic material of endangered, endemic and economically significant flora.

National Steering Committee meeting in Perth

The timing could not have been better for joining the ASBP as our annual face to face meeting was held in Perth at the end of April. I took the opportunity to stop in Adelaide first and meet with Lucy and our South Australian partners for a download on the history of ASBP. I also managed to meet with the Council of Heads of Australian Botanic Gardens (CHABG) Treasurer and received a tour of South Australia's Seed Conservation Centre.

The meeting in Perth was a great opportunity to review past achievements, explore future challenges and strategise



Collecting native flora and true bugs at Croajingolong National Park, Victoria. Photo: Damian Wrigley

on the remaining actions under our Business Plan. We were lucky enough to be joined by Dr Elinor Breman, Conservation Partnership Coordinator (Australia, Europe and the Middle East) from Kew's Millennium Seed Bank Partnership (MSBP). Elinor provided an update on MSBP's priorities for global plant conservation as well as opportunities for ASBP to contribute further to MSBP's target of banking 25 per cent of global species by 2020. I took some extra time in Perth with Elinor to discuss ASBP's engagement with Kew and explore future opportunities for ongoing collaboration. The ASBP appreciates MSBP's ongoing support and I look forward to building on this in the future. Thank you to David Merritt (Botanic Gardens and Parks Authority) and Anne Cochrane (Threatened Flora Seed Centre) for hosting the partners in Perth and providing a tour of their seed banking facilities.

Business Plan 2011-2020

The ASBP's Business Plan 2011-2020 sets out a comprehensive agenda of actions to assist us achieve our goals. Whilst the partnership is making significant progress, there still remain initiatives that we aim to

deliver by 2020. As new species are collected and the viability of seed verified, we edge closer to our target of contributing 1000 species to Australia's conservation seed banks.

We are also adding new tree species to the MSBP under the Garfield Weston funded Global Tree Seed Project. As I write this Brett Summerell and Gavin Phillips (Australian PlantBank) are taking advantage of the latest Bush Blitz expedition to Lake Mungo, NSW to bolster their collections. Field trips such as these require a huge effort from our partner's right across the country. Securing viable collections from remote areas is a constant challenge, as is the need to modify collecting efforts in response to a changing climate.

The ASBP will also continue to explore opportunities for implementing our Plants on the Precipice and Crop Wild Relatives projects. Delivering these will require significant investment and concerted efforts from not only our collecting partners but also our valued associates, such as the Australian Grains Genebank. There is always more to do and we will update you on progress against each of our goals in our 2016-2017 Annual Report to be released later this year.

Threatened Species Prospectus

The Threatened Species Commissioner, Gregory Andrews is a valued supporter of the ASBP and we thank him for his continuing advocacy for conservation seed banking in Australia. I met with the Commissioner recently to discuss our collaboration through the Threatened Species Prospectus. The ASBP is actively seeking a funding partner to support banking an additional 300 Eucalypt species over three years under the *Safeguarding Australia's Threatened Gum Trees* project. The ASBP has also committed to partnering with governments and other organisations on the *Securing our Alpine Threatened Plants in the Face of Climate Change* and *Securing Norfolk Island Threatened Plants* projects. If you are interested in supporting any of these projects I would be happy to hear from you.

6th Global Botanic Gardens Congress and Millennium Seed Bank

The ASBP was invited to speak at the 6th Global Botanic Gardens Congress in Geneva in June to highlight the success of Australia's collaborative efforts in conservation seed banking. The Congress was a great opportunity to meet with other delegates from Australia and around the world and contribute to building our collective capacity. I was honoured to accept the Botanic Gardens Conservation International (BGCI) Global Seed Conservation Challenge Award on behalf of the Australian PlantBank at the Australian Botanic Gardens, Mount Annan for their significant contributions to conserving Australian native seeds. Many of these collections were made with funding support from ASBP projects. It was also wonderful to hear that the Royal Botanic Gardens Victoria will host the 7th Global Botanic Gardens Congress in Melbourne in 2021.

Following the Congress I took the opportunity to visit the Royal Botanic Gardens, Kew and the Millennium Seed Bank, Wakehurst to further explore opportunities for ASBP to contribute to the MSBP's efforts in conservation seed banking. Thank you to the Director of National Parks and the members of the Council of Heads of Australian Botanic Gardens for their generous financial support, without which this trip would not have been possible.

I look forward to working with many of you over the coming years and hope to build on the Australian Seed Bank Partnership's global reputation for what is achievable through collaborative conservation seed banking.

If you would like to discuss opportunities to collaborate with the ASBP, volunteer with one of our partners or share your ideas for seed conservation, please send me an email at coordinator@seedpartnership.org.au; or call me on (02) 6250 9473 or 0418 955 661.



(Left to right) A highlight for Damian on the Mallecoota Bush Blitz – helping to collect *Notothixos subaureus* a hemiparasite on *Dendrophthoe vitellina*, which was parasitic on a branch of *Angophora floribunda*. The Botanic Gardens Conservation International (BGCI) Global Seed Conservation Challenge Award granted to the Australian PlantBank at the Australian Botanic Gardens, Mount Annan. Photos: Damian Wrigley

ANPC Member Profile

DARREN CRAYN

Australian Tropical Herbarium, James Cook University
www.ath.org.au
Email: darren.crayn@jcu.edu.au

What is your current position?

Professor and Director, Australian Tropical Herbarium

What project(s) are you working on at the moment?

Colleagues and I are working towards a better understanding of the conservation status of Australia's tropical cloud forest flora. Supported by the Ian Potter Foundation and the Australian Rhododendron Society Victoria Branch, we are conducting systematic surveys of mountain forests above 1000 m elevation in the Wet Tropics for about 30 plants that are endemic to these habitats. The objective is to get better data on distribution and abundance in the field to improve our species distribution models, which, based on current (very limited!) data indicate these species are in grave danger from climate change. So far we've added more than 850 precisely geocoded occurrence records of these 30+ species. Furthermore, a raft of serendipitous discoveries has been made. For example the bryologists on the surveys have discovered at least five species of moss and liverwort that are new to science, and more than 15 species newly recorded for Australia. Additionally, in the last few weeks we think we have re-discovered a filmy fern listed as extinct in the wild under the Environment Protection and Biodiversity Conservation Act (1999), and collected a new grammitid fern species and several new records for Australia.

How did you end up working in plant conservation?

My training, and most of my career to date has been in taxonomy and systematics, and evolutionary biology. While the conservation implications of my research have always been obvious to me, it has really only been in the last few years that I've started to design research projects specifically on conservation. The mountain cloud forest project, a current major program which is conservation-focused, stemmed from some species distribution modelling my former postdoctoral researcher, Craig Costion, published a few years ago.

The Australian Tropical Herbarium has been a Small Business member of the ANPC since 2012. Why do you think the ANPC is important and what do you see as our priorities?



Darren Crayn in the Daintree rainforest. Photo: Gary Wilson



The arching crowns of Mountain Teatree (*Leptospermum wooroonooran*) displaying 'crown shyness'. Photo: Andrea Lim

I think one of the most important roles of the ANPC is in brokering science into conservation practice. There are a lot of great scientists and science projects that produce conservation-relevant knowledge, and a vast community of excellent conservation practitioners working on the ground. It's not always the case that these two camps work hand in hand to the extent that they should. If conservation is to be effective it should be evidence-based, and so building and supporting relationships between scientists and practitioners is critical. The ANPC is leading the way in doing this in the plant space and I sincerely hope it remains a priority for the organisation.

What is your favourite plant and why?

That's a tough one, it's fluid, and tends to reflect whichever species I'm spending most time with! Lately, the one that has been on my mind is the Mountain Teatree, *Leptospermum wooroonoran*, a canopy tree with a mighty, arching crown that is characteristic of ridgetops in the Wet Tropics cloud forests. Apart from being visually stunning it is a significant contributor to the water balance of these cloud forests, as its dense crown of small

leaves, and the mosses that festoon its branches, strip moisture from the clouds that blow through and deliver it to these ecosystems and the rivers that arise from them. Studies have shown that this 'cloud stripping' by *L. wooroonoran* and other plants can contribute as much as 30% of the water input. The species is also one of the best examples of 'crown shyness' I have seen, whereby neighbouring trees partition aerial space so effectively that their crowns do not touch.

Are you considering provenance in your plant conservation work?

I'm a strong believer in the importance of provenance in plant conservation. We are hoping to soon begin planning an *ex situ* conservation program for the 30+ species of Wet Tropics cloud forest endemic plants that are in deep trouble according to climate niche distribution modelling studies. Provenance will be central to our strategy, which will aim to optimise the genetic diversity of the *ex situ* collections for resilience to known and unknown future threats.

Book reviews

Sheoaks - Wind Harps from Desert to the Sea

Neville Bonney. Published by Neville Bonney, PO Box 37 Tantanoola SA 5280.
Email: nbonney@senet.com.au
ISBN 978-0-646-96037-1 AUS \$40

Neville Bonney's publishing portfolio includes at least twenty other books on Australian native plants including species identification, plant uses and bush foods, seed collection and restoration and landscapes. His books always impart his knowledge, research and passion for the subject at hand, and always with beautiful photography and illustrations.

Sheoaks - Wind Harps from Desert to the Sea is no different - a story of the Sheoak group of plants' evolution, botanical history, distribution, conservation, revegetation and tool and decorative uses. It is both an informative book and visually beautiful. It is not aimed at an academic audience but includes lots of background research and historical details and will appeal to anyone that loves their plants and wants to know or appreciate more.

It is not inclusive of all Sheoak species but covers a wide range and geography complete with species descriptions. The book outlines the first European

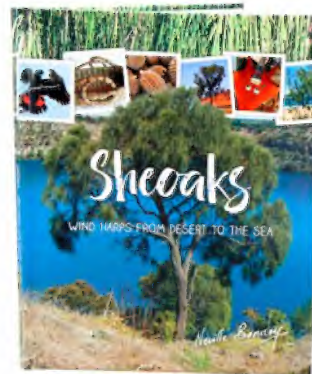
historical connections with Sheoaks and the links with Indigenous utilisation and artefacts and subsequent European settlement and use. This includes possibly the first ever boats built of native timbers by early European settlers.

It covers background botanical and group classification as well as species descriptions and photos of sawn timbers, fruits, seed and tree forms. It covers a lot of historical and cultural uses and the export of the genetic material to other countries and subsequent world recognition. It also includes case studies of people who love Sheoaks and what initiated or drives their passion and how the plants play a part in their lives or creativity.

Neville also covers his experience in ecology, restoration, revegetation and landscaping with case studies and photos.

All in all a great read and a great addition to your library.

Martin Driver



Woodland flora: a Field guide for the Southern Tablelands (NSW and ACT)

Sarah Sharp, Rainer Rehwinkel, Dave Mallinson and David Eddy. (2015).

Friends of Grasslands, Canberra.

ISBN 978-0-994 4958-0-8. 285pp.

The book can be ordered on-line at booksales@fog.org.au for \$25 a copy and \$13 postage and handling. Bulk orders can be arranged. The book is also available at specialist bookshops and outlets in the ACT.

The grasslands and grassy woodlands of the Tablelands are amongst the most attractive and diverse plant communities in Australia. It took European Australians a long time to appreciate the grassy woodlands. The richness and diversity of the sandstone flora were selling points in Joseph Banks' pitch for establishment of a new colony, but the colonists were very rapidly disillusioned by the low agricultural productivity of the landscape around Sydney. The more open plant communities of the Tablelands were seen as much more promising agriculturally, and once discovered were rapidly developed, with little thought for conservation. It was only in the latter half of the 20th century that appreciation of the richness of the flora of the Tablelands began to develop. The flora perhaps did not have the flamboyance of elements of the sandstone flora but many species had their own more subtle beauty. The landscape too had its own beauty, particularly in the cooler months when it is often illuminated by a golden light, as is illustrated on the cover of this book.

The Friends of Grasslands have played a major role in increasing our knowledge of the grasslands and grassy woodlands and in educating the wider public as to their value and to the many threats to their survival.

Sarah Sharp and her co-authors have produced an exemplary field guide to the grassy woodlands of the ACT and Southern Tablelands.

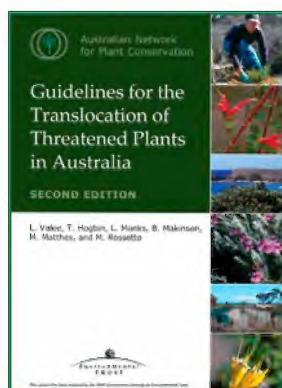
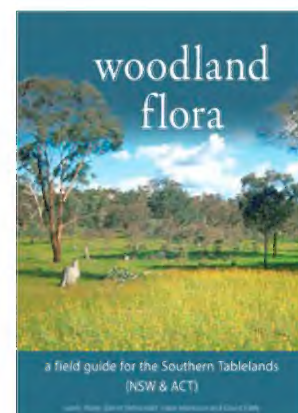
Ecologically there is no distinction between the ACT and the surrounding NSW, although the conservation and planning regimes differ, but the ACT is a centre of population with many keen to understand their environment and also sustains the support base which makes such publications possible.

The Field Guide will be an essential addition to the glove box of anyone resident, or person travelling, in the region, but will also be of much broader interest.

There is a succinct introduction to the distribution and ecology of the grassy woodlands and useful tips to identification of eucalypts, wattles and peas. The majority of the guide is made up of descriptions and photographs of species, arranged by growth form. Most of the species included are native but a number of the more obvious introduced species, particularly shrubs, are also covered, and this will be a very useful feature for beginners.

The Friends of Grasslands should be congratulated on this timely handsome book, which deserves wide sales.

Paul Adam



Guidelines for the Translocation of Threatened Plants in Australia

The deliberate transfer of plants or regenerative plant material from one place to another (eg re-introduction, introduction, re-stocking).

Second Edition 2004 | L. Vallee, T. Hogbin, L. Monks, B. Makinson, M. Matthes and M. Rossetto
Australian Network for Plant Conservation, Canberra.

For more information and to order, go to <http://www.anpc.asn.au/translocation>

ANPC Workshop Reports

Successful translocation workshops held

In the first week of August the ANPC ran two translocation events in Sydney, with the support of the Threatened Species Recovery Hub (TSR Hub), the Royal Botanic Garden Sydney (RBG) and the NSW Office of Environment and Heritage (OEH).

On Tuesday 1 August, 90 people gathered at the RBG's Maiden Theatre for the Threatened Plants Translocation Information Day **#PlantsGoingPlaces** demonstrating a huge interest in plant translocation. Sebastian Lang from the Office of the Threatened Species Commissioner opened the series of presentations by speaking on Australia's Threatened Species Strategy, and Kim Ellis welcomed attendees to the RBG.

The information day showcased 16 presentations by local and national experts on plant translocation, with topics including a review of plant translocations in Australia, policy, licensing, provenance, orchids, propagation, and several case studies including *Asterolasia buxifolia*, *Fontainea oraria*, *Persoonia pauciflora*,

and *Wollemia nobilis*. ANPC committee members Linda Broadhurst, Cathy Offord, Bob Makinson, and Dave Coates all gave presentations. I presented on the review and update of the ANPC's *Guidelines for the Translocation of Threatened Plants in Australia*. The presentations were audio recorded and will soon be made available online.

Heidi Zimmer from OEH and Cathy Offord and staff from the RBG were instrumental in organising the day. Rachel Morgain and Jaana Dielenberg from the TSR Hub provided media support.

The feedback from attendees has been exceptionally positive, and I hope that the information provided will support those undertaking translocations in NSW, particularly those working in OEH.

Following the Information Day, on Wednesday 2 and Thursday 3 August, 30 translocation experts gathered from across Australia to commence the process of updating the Translocation Guidelines. The venue was once again kindly provided by the RBG.



Participants at the Translocation Guidelines Review national consultation workshop. Standing, left to right: Jen Silcock, Doug Bickerton, Andrew Benwell, Tom North, Rachael Gallagher, Linda Broadhurst, Joslin Moore, David Coates, Paul Adam, Marc Freestone, Rebecca Dillon, Nigel Swarts, Noushka Reiter, Heidi Zimmer, Laura Simmonds, Neville Walsh, Tony Auld, Mark Ooi, Andrew Young, David Taylor and Bob Makinson. Sitting: Lucy Commander, Cathy Offord, Peter Vesk, Margaret Byrne, Maria Matthes, Leonie Monks and Maurizio Rossetto. Photo: Jo Lynch



Participants at the Threatened Plants Translocation Information Day held at the Royal Botanic Garden Sydney. Photo: Jo Lynch

Firstly, Jen Silcock from the TSR Hub provided an update on the review of plant translocations in Australia. We then discussed the new structure of the guidelines, including new content. After a group discussion on considering climate change when selecting source and recipient sites (a topic not covered in the second edition), we formed break-out groups to discuss each chapter. We also identified case studies, which will be included (in full or in part) in the guidelines, as well as being published in APC and online. Finally, we discussed a publicity strategy to ensure uptake and usage of the guidelines.

The workshop ran smoothly, and everyone was keen to participate in discussions. The next step for the revision is to identify lead and co-authors for each chapter, and start revising and writing the content. A final draft will be produced by mid 2018.

I would particularly like to thank my steering committee for their support, especially Cathy Offord who organised the venue and logistics. Funding was provided for the workshop, and for travel and accommodation for many of the participants, by the TSR Hub as part of Project 4.3 - 'Improving threatened plant reintroduction success which is managed by David Coates.

Lucy Commander
 ANPC Project Manager, Translocation
translocation@anpc.asn.au
http://anpc.asn.au/translocation_guidelines_review



Lucy Commander presenting on the review of the Translocation Guidelines at the Threatened Plants Translocation Information Day. Photo: Nathan Emery

'Seeing Beyond the Wood and Trees for the Grass at Wynwood Station' Plant Identification Workshop at Mount Hope, NSW, June 2017

A recent property tour incorporating an ANPC native plant identification and vegetation management workshop was held at Wynwood Station north of Mount Hope in western NSW on 14 June 2017. Local landholders and interested community group members attended this workshop, with support from Western Local Land Services (LLS). You know it's been a good field day when one of the landholders attending takes the time to fill out the feedback form with "one of the best practical field days I've been to, top stuff"!!

ANPC Project Manager, Martin Driver, presented at the workshop. A grazier himself, Martin highlighted the importance of indicator species such as perennial grasses and how you can use these plants as a tool to assist with your grazing decisions. How this day exceeded the usual expectations was by incorporating a focus on grazing management, and weed and Invasive Native Shrub (INS) control and management, all issues that are at the forefront of many graziers' minds in the Western LLS region.

The day started with an inspection of a site with beautiful stands of mature Western Red Box (*Eucalyptus intertexta*) and aged regrowth Poplar/Bimble Box (*E. populnea*), with a mixed understorey of Wilga (*Geijera parviflora*), shrubs and a diverse native grass layer. This set the scene to outline the ecology of these woodlands and the response to the visible 'ringing' of the large trees in the 1870's, the historical overgrazing by domestic and feral animals, the removal of grass fuel and fire, and the subsequent invasion of native shrub and tree species. The importance of maintaining a diverse, species rich and productive perennial grass base was discussed, along with key grass palatability/nutritional and grazing response issues, as well as the use of patch fire as a supplementary management tool. Due to effective use of controlled cattle grazing and subdivisional fencing there was a magnificent range of native grass species present including Curly Windmill (*Chloris truncata*), Mulga Grass (*Aristida contorta*), Bandicoot Grass (*Monachather paradoxa*), Spear Grass (*Austrostipa* sp.) and even Kangaroo Grass (*Themeda triandra*).



Local Land
Services



Martin Driver (left) at the Plant ID Workshop at Wynwood Station.
Photo: Jasmine Wells

A range of other vegetation communities, species and management issues were inspected and discussed. The importance of management of INS as opposed to eradication, and where and how to identify where you concentrate your efforts and resources, was a key element in maintaining the natural resources and a diversity and regeneration of the valuable species. Martin then discussed how these decisions have been beneficial in getting to the stage his property is at now, which was really beneficial in tying it all together.

One of the many highlights of the day was how forthcoming everyone was with sharing their experiences and frustrations, and helping one another to move towards desired goals such as increased ground cover, an increase in palatable species, a reduction in INS or reduced thistle incursions. John Vagg from Wongaroa

Station simplified exactly what graziers are trying to do, 'convert sunlight into money' and identified how days like this are so beneficial to their business to assist them to identify the mix of species they have and manage their business accordingly.

It was a great opportunity to spend time with inspiring landholders and the feedback was very positive. Having the opportunity to see the response of the country to recent management decisions by the landowners was a privilege and a great learning experience.

Western LLS will be running another plant identification workshop west of Hillston later in the year. Any inquiries or suggestions can be directed to Jasmine Wells, 0417488496 or Shae Brennan 0447 337 653.

Jasmine Wells, Western LLS and Martin Driver, ANPC.

NEW Plant Germplasm Conservation in Australia (E-version)

Strategies and guidelines for developing, managing and utilising ex situ collections

Australia + International orders \$5.00

FREE FOR MEMBERS ONLY

For more information and to order, go to <http://anpc.asn.au/publication-form>

Fully revised edition 2009

**Edited by C.A. Offord
and P.F. Meagher**

Full of practical case studies on germplasm conservation including seed collection, banking, germination and dormancy.



News

Murray Wild Orchids Project

This Saving our Species Partnership Grants Project is a collaborative effort between the ANPC and Murray Local Land Services (lead agency), Office of Environment and Heritage, Department of Primary Industries - Lands, Royal Botanic Gardens Victoria, Forestry Corporation of NSW, NSW National Parks and Wildlife service, plus many landholders. The project is contributing over a 10 year period to the long-term viability of three endangered orchid species in the Murray region: the Crimson Spider-Orchid (*Caladenia concolor*), the Sandhill Spider Orchid (*Caladenia arenaria*) and the Oaklands Diuris (*Diuris callitrophila*). These highly threatened orchids now only occur in very small numbers in the wild, and are at considerable risk of extinction from natural events or human-induced disturbances. Activities include propagation, weed control, reintroduction and pollinator surveys. Project factsheets are now available. http://anpc.asn.au/wild_orchids

'Along the Bush Tracks' 3rd edition booklet launched in Albury on 25 May 2017

Over 90 people attended the launch at the Albury Library Museum, of the 'Along the Bush Tracks' booklet for discovering the hilltop bushlands of Albury-Wodonga including plants, birds, cultural heritage and trails. ANPC Project Manager Martin Driver launched the booklet and spoke about the value of bushland on the doorstep. The revision of the booklet was a collaboration between Murray Local Land Services, Office of Environment and Heritage, Albury-Wodonga Field Naturalists Club, Albury City Council, City of Wodonga and Parklands Albury Wodonga. <http://www.alburyconservationco.org.au/wp-content/uploads/2013/06/BUSH-TRACKS.pdf>



Martin Driver at the launch of the Along the Bush Tracks booklet. Photo. Martin Driver

ABC Open video of the ANPC Sandhill Paddock Walk near Hay NSW held in September 2016

Produced by filmmaker Richard Snashall. The walk was organised by the ANPC and Riverina Local Land Services, and led by ANPC Project Manager Martin Driver. It focused on 'Sandhill Pine Woodland in the Riverina' which is listed as an Endangered Ecological Community in NSW. The aim was to increase plant identification skills and highlight the importance of revegetation. The extraordinary rainfall in the Riverina last winter resulted in an explosion of native plant growth and germination at both properties visited. <https://open.abc.net.au/explore/180752>

Australian PlantBank wins Global Seed Conservation Challenge award for its work to save our threatened flora seeds

The Australian PlantBank has won a prestigious Global Seed Conservation Challenge Award recognising the world class collecting and research efforts of the PlantBank's science team. PlantBank, at the Australian Botanic Garden, Mt Annan, stores more than 50 per cent of NSW's threatened flora seeds, 5300 Australian species and 10,400 individual seed packets. <http://www.dailytelegraph.com.au/newslocal/macarthur/australian-plantbank-wins-global-seed-conservation-challenge-award-for-its-work-to-save-our-threatened-flora-seeds/news-story/adff7b29217e3fe3536d0d7e44a2fdef>

Information guide is now available for the 'Banksia Woodlands of the Swan Coastal Plain' ecological community

This ecological community was listed as endangered under the Environment Protection and Biodiversity Conservation Act 1999 in September 2016. The guide is intended to assist the public to understand the national listing of the Banksia Woodlands of the Swan Coastal Plain ecological community – What it is? Why it is threatened? What does national protection mean for people in the region? This guide accompanies the approved Conservation Advice, which is the definitive source of information on the ecological community. <http://www.environment.gov.au/biodiversity/threatened/publications/banksia-woodlands-swan-coastal-plain-guide>

State of the World's Plants

Royal Botanic Gardens Kew has launched its second State of the World's Plants report, providing a cutting-edge horizon scan and taking stock of the world's most valuable and vulnerable plants. The 2017 State of the World's Plants report aims to provide an overview of current knowledge of the world's plants. Building on the success of last year's report, this year they look not only at the numbers of plants, but also why they are important and what drives variations in resilience to threats of climate change, wildfires and pests. Scientists from around the globe have worked in collaboration with Kew to scrutinise databases, published literature, policy documents, reports and satellite imagery to synthesise the latest discoveries and knowledge into this horizon-scanning report. <http://www.kew.org/science/who-we-are-and-what-we-do/strategic-outputs-2020/state-of-the-worlds-plants>

Rainforest Plants of Australia – Rockhampton to Victoria, by Gwen Harden et. al. is now available as an app for your mobile device.

The app is based on the popular computer key (distributed as a USB) of the same name. It identifies trees, shrubs and climbing plants that occur naturally or have become naturalized (including exotic weeds) in rainforest from Rockhampton to Victoria. At the core of this app is an interactive identification key powered by Lucid. The key includes 1140 plant species, to help confirm identification the app provides line drawings, over 8000 photos and extensive information on each species, including previously unavailable botanical details. A customised image gallery walk-through tutorial assists the user in working the key and accessing the content. Note: once installed an internet connection is not required, so great for field work. Available for both Android and Apple phones. <http://rainforests.net.au/>

Myrtle rust plant scourge spreads to New Zealand

New Zealanders have received a rude shock with the discovery of the plant-killing fungal disease Myrtle rust on the north island. It's the first time the rust has been detected on the country's mainland and the Kiwis are showing Australia a thing or two about how to mount a biosecurity response. <https://invasives.org.au/blog/myrtle-rust-plant-scurge-spreads-to-new-zealand/>

People are 'blind' to plants, and that's bad news for conservation

"Plant blindness...impacts on our efforts to care for and understand plant species. Figures from the United States show that while most federal endangered species (57%) are plants, less than 4% of money spent on threatened species is used to protect plants." The authors propose three strategies for overcoming this blindness: identifying with plants through our similarities, fostering empathy with plants and making plants human through anthropomorphism. They also provide a link to the International Journal of Plant Sciences' article on 'Getting Plant Conservation Right (or Not): The Case of the United States'. <http://theconversation.com/people-are-blind-to-plants-and-thats-bad-news-for-conservation-65240>

Bringing rare Australian native plant *Banksia vincentia* back from the brink

An afternoon stroll by a nursery owner and her friend has turned up a new species of banksia that authorities are now working hard to protect. <http://www.abc.net.au/news/2016-11-23/bringing-rare-australian-native-plant-back-from-the-brink/8050670>. Watch the Vimeo Saving Australia's rarest Banksia at ABC Open Illawarra here <https://vimeo.com/192402484>

Plight of the Pomaderris

Hear about efforts to save critically endangered *Pomaderris walshii* which is currently known only from the upper catchment of the Kangaroo River within the Sydney Basin Bioregion. It occurs within about three lineal kilometres of riparian habitat in two small populations above the escarpment near Robertson. It occurs as two small populations within a total area of occurrence of about three lineal kilometres of riparian habitat, with very low numbers of individuals. <https://vimeo.com/202113757>

Two new plant species rise like a phoenix from the ashes of WA bushfires, then vanish

An internationally-renowned plant conservation biologist has discovered a new pennywort species rising from the ashes of two new major bushfires near Albany in Western Australia. <http://www.abc.net.au/news/2017-04-27/new-aquatic-plant-species-rises-from-ashes-of-major-wa-bushfires/8476668>

Shy Susan and the Bees

Hear about the Royal Tasmanian Botanical Garden's Tasmanian Seed Conservation Centre's efforts to save *Tetradlea gunnii* (Shy Susan) and its native bee pollinators. This plant is limited in the wild to the Beaconsfield area in northern Tasmania, where it's represented by fewer than 250 individuals.. An amazing example of the intricate inter-relationships between plants and animals. <http://www.abc.net.au/radionational/programs/offtrack/shy-susan-and-the-bees/8578762>

Extinct native plant in Victoria getting second chance at life

Swainsonia recta, a vivid purple native flower recently declared extinct in Victoria, is getting a second chance at life thanks to a major biodiversity project. A five-year program was rolled out in 2012 to reintroduce the wild pea in Victoria and around 1000 seedlings have so far been planted. http://www.abc.net.au/news/2017-06-23/extinct-native-plant-in-victoria-getting-second-chance-at-life/8646922?utm_

Botanist visits wattle seedlings planted 41 years ago at Lake Lonsdale

Fifty seedlings of Jumping-jack Wattle (*Acacia enterocarpa*) were planted at Lonsdale Nature Reserve in 1976 by botanists John Stuwe and Bob Parsons, who were concerned about the future of the species. As part of a national review of threatened plants, Dr Jennifer Silcock visited the site and was delighted to find that 40 years on, the wattle were thriving, "There are now over 110 wattles at the reserve and they have spread beyond the fence – a great outcome." <http://www.stawelltimes.com.au/story/4821732/botanist-visits-wattle-seedlings-planted-41-years-ago-at-lake-lonsdale/>

Revealed: the first ever flower, 140 million years ago, looked like a magnolia

A team of botanists have compared the similarities and differences among 800 flowering plants and worked backwards to reveal the first ever flower. <http://theconversation.com/revealed-the-first-ever-flower-140m-years-ago-looked-like-a-magnolia-81861>

Conferences and Courses

Wetland Ecology and Training Courses, Rakali Ecological Consultants - Victoria, October 2017 - March 2018

Registrations are now open for three wetland courses commencing October 2017, presented by SERA award winning ecologist Damien Cook and Elaine Bayes. Each course can be done as an individual unit or as a complete (discounted) package.

THE WONDERFUL WETLAND ECOLOGY BUS TOUR, 12 & 13 OCT 2017 – Join us on a bus tour through some of northern Victoria's most ecologically diverse wetlands that will be looking their best because of recent rainfall and flooding. Learn how ecological drivers determine wetland ecology.

WETLAND RESTORATION AND MANAGEMENT, 16 & 17 NOV 2017 – Learn about wetland restoration and management over 2 days with Damien Cook by visiting 'Waterways'; an award-winning wetland restoration project which he was involved in planning and implementing, followed by the 200 hectares of coastal park at the Victorian Desalination Plant, Wonthaggi.

THE WETLAND PLANT IDENTIFICATION COURSE STARTS OCT 2017 – Learn easy identification of the most common wetland plants focusing on a different wetland habitats and timed so as to follow the wetting and drying of the stunning Reedy Lagoon at Gunbower Island or nearby wetlands. <http://rakali.com.au/education-and-training-2/>

19th NSW Weeds Conference 2017 - Armidale, 16-19 October 2017

Registrations are now open! With the introduction of the new Biosecurity Act 2015 and proposed Regulation in 2016 that provides a framework for the prevention, elimination and minimisation of biosecurity risks to the economy, environment and communities, coupled with the Invasive Species Plan 2015- 2022 objectives, there has never been a more important time for weed professionals to be able to meet the challenges of the practical implementation of these changes within the industry. Our theme of 'Experience the highs – working smarter together' looks to build on the successes of the past whilst looking to the future as we transition into this new era in weed management and control, an approach that must be based on regional

cooperation as well as providing a common focus for the actions of the numerous land managers across all tenures. With this in mind Session themes will broadly revolve around Biosecurity in Action; Technology & Innovation; Community, Extension & Social Marketing; Collaboration & Case Studies with a special feature being the Open Debate. <http://conferencecompany.com.au/weedsconference/>

National Private Land Conservation Conference - Hobart, TAS, 18-20 October 2017

The theme of the 2017 National Private Land Conservation Conference is **Valuing Nature** exploring the diverse aspects of value, from natural capital and ecosystem services, to community and cultural connections, and the inherent value of nature for its own sake. Join conversations on the value of nature on private land, and how these benefits are measured and communicated. Topics covered will include natural capital, communication and education, conservation policy and the law, land management, and monitoring and evaluation. Registration opens 21 August 2017. <http://plc-conference.org.au/>

2017 NSW Landcare and Local Land Services Conference - Albury, 25-27 October 2017

The 2017 NSW Landcare and Local Land Services Conference will be held at the Albury Entertainment Centre. The Conference is being hosted by Landcare NSW and Murray Local Land Services, and is being coordinated in partnership with local Landcare and community groups. The theme for the Conference is 'Sharing our Stories'. Conference topics will focus on agriculture, biodiversity, water and Aboriginal Landcare. Renowned science communicator, Dr Karl Kruszelnicki, will be the keynote speaker at the conference. This conference is the premier event to showcase sustainability, Landcare and volunteering across NSW and includes the annual Landcare Muster and the NSW State Landcare Awards. Don't miss this chance to gather with around 300 people from Landcare and community groups, farmers, Aboriginal groups, industry and government representatives from across NSW and Australia. <http://nswlandcareconference.com.au/>

New Zealand Plant Conservation Network Conference Hokitika, New Zealand, 14-18 November 2017

Registrations are now open for the NZPCN 2017 biennial conference. The conference offers an exciting range of presentations, workshops and field trips. A charity auction and the 2017 NZPCN Plant Conservation Awards will also be held during the conference. Abstract submissions close on 8 September. Register before 30 September to take advantage of early-bird prices.
http://www.nzpcn.org.nz/page.aspx?nzpcn_events_conference_2017

Territory Natural Resource Management Conference - Darwin, NT, 21-23 November 2017

This year's conference theme is **NRM it starts with you**. The conference showcases and advances activities related to sustainably managing the Territory's land, water and biodiversity. The 2017 Program includes a mix of podium presentations, interactive workshops, displays, field trips and opportunities for delegates and event partners to meet and network. <https://www.tnrmconference.org.au/>

Rainforest Plant Identification Short Course - James Cook University Research Station, Paluma, 24-26 November 2017

Presented by the Australian Tropical Herbarium and the Wet Tropics Management Authority this three day introductory short course will introduce participants to the skills and resources needed for rainforest plant identification. The short course will cover:

- What is a rainforest
- How plants are named
- Plant structure and terminology
- A walking tour of nearby rainforest, and hands-on learning through identification of local native plants.
- A review of important rainforest plant families, and the features used to identify them in the field

<https://alumni.jcu.edu.au/PIC2017>

Joint conference of the Ecological Society of Australia and the New Zealand Ecological Society - Hunter Valley, NSW, 26 November - 1 December 2017

The Ecological Society of Australia and the New Zealand Ecological Society are delighted to announce EcoTAS 2017, the sixth joint meeting organised by the two societies. Bridging the Tasman every four years, this combined annual meeting always delivers top-quality ecological science drawn from all ecological subdisciplines from throughout Australasia and beyond. EcoTAS 2017 promises an exciting programme of plenary speakers, symposia, workshops and social events, all held in the beautiful Hunter Valley. The theme of EcoTAS 2017, 'Putting ecology to work', is a call to focus on how ecological science can contribute to the economy, society, culture and public policy, as well as to the health of the environment and quality of life. As ecologists, we should identify and communicate the impact of our work and the tangible benefits it can deliver.
<http://ecotas2017.org.au/>

Research Roundup

COMPILED BY KIRSTEN COWLEY

Centre for Plant Biodiversity Research, Canberra
Email: Kirsten.Cowley@csiro.au

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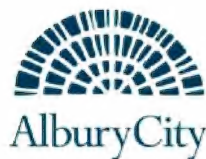
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Photo Credits:

- *Tetratheca gunnii* (Shy Pinkbells), an endangered, endemic species with an extremely restricted distribution near Beaconsfield, northern Tasmania. Photo: Royal Tasmanian Botanical Gardens
- Our youngest ever workshop participant, at an ANPC Plant ID workshop October 2013. Photo: Tricia Hogbin

The development of the Kids Hub is being assisted by the New South Wales Government through its Environmental Trust.



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